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रोटरी स्क्रू वायु संपीड़क (तेल-प्लावित) के चयन एवं परीक्षण करने की संहिता

(पहला पुनरीक्षण)

Code for Selection and Testing of Rotary Screw Air Compressor (Oil-Flooded)

(First Revision)

ICS 23.140

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May 2023 **Price Group 5**

Compressor, Blowers and Exhausters Sectional Committee, MED 22

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Compressor, Blowers and Exhausters Sectional Committee had been approved by the Mechanical Engineering Division Council.

This standard was first published in 1986. The present revision has been taken up with a view to incorporating the modifications found necessary as a result of experience gained in the use of this standard. Also, in this revision, the standard has been brought into latest style and format of Indian Standards, and references to Indian Standards, wherever applicable have been updated. In this revision, the following major changes have been made:

a) Clause **3.13** has been modified; and
b) A new clause **7.10.5** has been added on cartridge-type oil filters.

The composition of the Committee responsible for the formulation of this standard is listed in Annex A.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test shall be rounded off in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

CODE FOR SELECTION AND TESTING OF ROTARY SCREW AIR COMPRESSOR (OIL-FLOODED)

(First Revision)

1 SCOPE

This standard covers the general method of selection and testing of rotary screw air compressors (oil-flooded) up to 25 bar pressure.

2 REFERENCES

The standards listed below contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to the agreement based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below:

IS No.	*Title*
IS 1367 (Part 1) : 2014/ISO 8992 : 2005	Technical supply conditions for threaded steel fasteners: Part 1 General requirements for bolts, screws, studs and nuts (*fourth revision*)
IS 2825 : 1969	Code for unfired pressure vessels

3 COMPRESSOR

3.1 All equipment shall be suitable for specified operating conditions and shall work under continuous full load duty for at least one year.

3.2 Number of compression stages, compressor arrangement, type of drive, prime mover, free air delivery, energy consumption, coolant arrangement, etc, shall be as per agreement between the manufacturer or the supplier and the purchaser before the order is placed.

3.3 The purchaser has to provide adequate space for erection, maintenance, and operation.

3.4 In the case of a liquid injection system, the type, and characteristics of liquid shall be given to the purchaser.

3.5 Coolant characteristics, pressure, and flow shall be given to the purchaser. If it is not given fresh water at suitable pressure shall be used. Flow rates shall be specified by the manufacturer.

3.6 Critical parts working under pressure, such as oil coolers, pressure pipes, hoses, and couplings, critical castings shall be hydraulically tested at 1.5 times the operating pressure.

3.7 Studs and bolts used on compressor be heat-treated and shall conform to IS 1367 (Part 1).

3.7.1 All the fasteners shall be so designed that they shall not get loose during the service.

3.8 In all pipe connections, flanges are necessary for pipe sizes 50 mm NB and above. In pipe connection below 50 mm NB threaded connections shall be used.

3.9 Rotor and shaft shall be made of one piece.

3.10 All bearings shall be of a replaceable type. Radial and thrust bearings shall be adequately lubricated.

3.11 Lubricant seals shall be provided to prevent leakages.

3.12 Compressor rotors shall be dynamically balanced.

3.13 Name plate of the compressor shall give the following data:

a) Manufacturer’s name or trade-mark (if any);
b) Model designation and serial number;
c) Capacity;
d) Discharge absolute pressure; and
e) kW (Horsepower).

3.14 Direction of rotation of the compressor drive shaft shall be clearly shown by an arrow on the compressor casing.

4 PRIME MOVER AND DRIVE EQUIPMENT

4.1 Prime mover shall be sized considering transmission losses, power used for cooling fans, frictional losses, etc.

4.2 Electric Motor

An electric motor shall be rated for continuous output power of at least 110 percent of the maximum power required at any specified operation point, under balanced voltage conditions.

4.3 Combustion engine rating shall be as agreed to between the manufacturer and the purchaser.

4.4 Where the prime mover is of the reciprocating type, a torsional analysis of the complete system shall be carried out and this shall be the responsibility of the party supplying the prime mover.

4.5 Transmission Gears

4.5.1 Main transmission gears shall be capable of continuously transmitting the rated prime power multiplied by the application factor as given below:

Sl No. (1)	*Prime Mover* (2)	*Application Factor* (3)
i)	Electric motor	1.3
ii)	Engine with 4 to 7 cylinders	1.3
iii)	Engine with 8 or more cylinders	1.4
iv)	Steam turbine	1.3
v)	Gas turbine	1.3

4.5.2 The main transmission gears shall be rated to transmit the maximum torque available from the prime mover under all operating conditions including starting torque.

4.5.3 Lubricant shall be specified by the manufacturer as compatible with ambient temperature – 5 °C to 55 °C.

4.6 Coupling

4.6.1 The connections between the prime mover and compressor shall make allowance for misalignment between the shafts. If the compressor and gearbox are mounted on a base frame and the prime mover mounted separately, a coupling shall be used to take up any differential expansion. The coupling arrangement between the prime mover and the compressor shall be such as to avoid undue vibration.

4.6.2 If the peripheral speed of the coupling exceeds 25 m/s, the metallic parts of the coupling shall be of suitable material.

4.6.3 It shall be capable of continuously transmitting the rated drive power multiplied by the application factor as given in **4.5.1**.

4.6.4 Coupling shall be rated to transmit the maximum torque under all operating conditions including starting torque.

4.6.5 Gear type coupling with proper lubrication or of proven design shall be used, if maximum shaft speed is above 3 600 rev/min.

4.6.6 Coupling shall be designed to allow the prime mover to be uncoupled.

4.6.7 Suitable guards shall be provided for coupling and shafts which are exposed.

5 INSPECTION — TESTING OF COMPRESSOR

5.1 The purchaser may be present during the testing of the compressor with a prior appointment.

5.2 If required by the purchaser, test certificates shall be provided by the manufacturer for the tests carried out.

5.3 Hydrostatic pressure test shall be carried out at 1.5 times the pressure designed for the component prior to assembly. The certificate shall be issued by the manufacturer for critical components such as pressure vessels, coolers, etc at the time of delivery.

5.4 Performance Test

a) Performance test shall be carried out on air, but the manufacturers shall provide equivalent air performance for the purchaser’s contract usage;

b) The test shall be carried out with the manufacturer’s equipment and test prime mover as far as possible. It is not necessary that the same equipment or prime mover is fitted on the compressor;

c) Each stage of the multistage compressor may be treated individually or as a complete unit;

d) Testing shall be done at least for 4 h as agreed to between the purchaser and the supplier; and

e) The test shall be carried out at a specified speed. If it is not possible to operate the compressor on the test bed at the actual specified conditions, due to power or other limitations, simulated testing shall be carried out.

6 COOLERS, SEPARATORS, TRAPS, AND TANKS

6.1 All the pressure vessels, shall be as per IS 2825.

6.2 Material

Materials shall be suitable for weldings and electrodes shall be compatible with the base material.

6.3 Coolers shall be designed to work under severe operating conditions (maximum coolant temperature, maximum flow rate, and maximum pressure) to be specified by the manufacturer.

6.4 Coolant

If coolant is not specified by the manufacturer and if no information is available, fresh water at specified pressure and temperature declared by the manufacturer shall be used.

6.5 Separators and Traps

Liquid separators shall be provided (if required). The separator shall be fitted with a drain trap and blow-off valves. Manually drained separators shall have the holding capacity to permit continuous full-duty utilization without drainage for 16 h.

6.6 Pipe Works

6.6.1 *Pipe Work*

The manufacturer shall define the location, size, and type of terminal connections.

6.6.2 The designed pressure of all pipework, flanges, and fittings shall be at least the highest pressure which may occur during the operating condition.

6.6.3 The pipe diameter shall be such that air or gas velocity shall not exceed 25 m/s.

6.6.4 All pipe work shall be arranged with proper access for operation, maintenance, and cleaning.

6.6.5 All pipe work and auxiliary piping shall be properly supported to avoid damages due to vibrations, thermal expansion, and self-weight.

6.6.6 Air and lubricant lines shall be of seamless carbon steel tubes and coolant lines shall be of seam welded pipe. Special or corrosion-resistant materials may be used, if required by the customer. Copper and plastic pipe are permissible for measuring and control lines and scavenging lines. Suitable high-pressure rating hoses and pipes may also be used.

6.6.7 A nominal effective pressure of 7 bar shall be taken as the minimum pressure rating for all connections on the delivery side.

6.6.8 Lubricant pipes running horizontally shall have a slope of at least 20 mm per linear metre (1 to 50) towards oil reservoir.

6.6.8.1 In the case of pressure operated lubrication system, it may not be necessary. Drain lines except instrument and control lines shall be of 10 mm internal diameter.

6.6.9 Pipe systems shall be made by bending or welding. Flanges shall be butt welded. Threaded connections may be used up to 50 mm internal diameter, and 12 bar pressure. Use of threaded connection shall be minimum.

7 LUBRICANT AND LIQUID SEAL SYSTEMS

7.1 A complete pressure lubricating system shall lubricate the following parts of the compressor (if applicable).

a) Gearbox and bearings;
b) Main drive bearings;
c) Couplings;
d) Turbine governor, trip, and throttle valve;
e) Shaft seal system; and
f) Timing gear.

7.2 If an external pump lubrication system is provided, then the manufacturer shall give lubricatingqualities, pressures, flows, etc.

7.2.1 Manufacturer shall supply another stand-by pump fitted on the compressor which shall take over automatically if the main pump fails and a trip arrangement is not provided. An accumulator shall be provided to maintain the pressure till the takeover is complete.

7.3 Grease nipples shall be easily accessible.

7.3.1 *Lubricant Reservoir*

If a separate lubricant reservoir is provided, the drain pipe shall have a slope of 75 mm/m.

7.3.2 Reservoir shall be sealed against dirt, water, etc. Opening at the top shall be raised. It shall have a drain plug at the bottom-most position. All pipe connections to the reservoir other than drain or control shall be flanged.

7.4 Size of the Tank

For safety in case of leakages or breakdown, the column between minimum operating level and pump inlet bottom-most position shall at least have oil sufficient for 2 min of operation or a suitable safety device shall be provided to protect the system. This is applicable if a pump is provided for oil circulation and pressurized lubrication.

7.5 Pressure control valve to be provided to maintain and control the lubricant pressure. When the main pump and standby pump both are working, the pressure shall be controlled within 15 percent. This is applicable, if a pump is provided for pressurized lubrication.

7.6 All exposed rotating parts shall have guards.

7.7 Lubricant Coolers

Minimum one cooler shall be provided and shall be able to take total heat load. Twin coolers may also be used.

7.8 Cooler shall be suitable for lubricant pressure. If coolant is not specified then fresh water so that suitable pressure and flow is taken as the cooling medium.

7.9 Inlet and draining connections shall be provided on the cooler.

7.10 Filters

7.10.1 Full flow lubricant filters capable of removing 25 µm particles shall be used. The filter element shall be of a replaceable type. Alternatively, throw-away filters shall be provided.

7.10.2 Filter casing and filter element shall be suitable for operating above the maximum discharge pressure of the lubricant pump.

7.10.3 Filters shall be located downstream of the cooler.

7.10.4 Filling and draining connections shall be provided for filters.

7.10.5 The requirements given above shall not apply to cartridge-type oil filters.

7.11 Liquid Injected Screw

7.11.1 A liquid may be injected into the gas being compressed in the screw. The purpose of the liquid injection is to improve performance, temperature control, and lubricating cooling of rotors and casings. The liquid may pass on along with gas or may be separated and recycled to the compressor after cooling and filtering. The requirement of **6** shall apply to liquid injected compressors also.

7.11.2 If the injected liquid is used as the compressor lubricant (as in the case of oil-injected compressor), the lubricant system pressure is related to discharge pressure. The compressor shaft seals and integral gearbox shall be lubricated by the compressor lubrication system.

7.11.2.1 Separate gearbox and main drive shall be lubricated by an independent system.

7.11.3 In liquid injected compressors, liquid (lubricant) is injected into the air or gas during compression. The mixture of compressed air or gas and lubricant is passed to a separator where air or gas is separated from the lubricant. Lubricant is fed to the cooler and filter and then to the compressor.

7.11.4 The oil content in supply air or gas shall be specified by the manufacturer.

7.11.5 Reservoir for lubricant injected compressor:

a) The reservoir may be combined with a separator or may be a separate vessel;
b) The reservoir shall have a drainage point for complete drainage;
c) Pipe connections above 50 mm to the reservoir shall be flanged except for control or indicator connections. Inlet connection shall be of 50 mm diameter minimum as far as possible; and
d) The level indicator shall be provided.

8 SAFETY SWITCHES

A suitable safety device shall be provided to trip or to give the audio-visual alarm to the equipment in case of an abnormal temperature rise as specified by the manufacturer.

9 MAINTENANCE AND OPERATING INSTRUCTIONS

The manufacturer shall supply the literature such as the user handbook (operating manual), part identification manual, and maintenance manual to the purchaser.

ANNEX A
(*Foreword*)

COMMITTEE COMPOSITION

Compressor, Blowers and Exhausters Sectional Committee, MED 22

Organization	*Representative(s)*
Bharat Petroleum Corporation Limited, Mumbai	Shri K. Ravi (***Chairperson***)
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SHRI LOKRAJ MEENA
SCIENTIST 'B'/ASSISTANT DIRECTOR
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